Quantum Gravity Idea

Tomasz Kobierzycki
*To whom correspondence should be addressed; E-mail: shizykfizyk@gmail.com

In this paper i will present hypothesis that may be model for quantum gravity. Basic idea is field equation that field equation leads to cyclic nature of spacetime. Model does not break at Planck's scale, it predicts spacetime loops at singularity of inside of a black hole.

Introduction

Quantum gravity is one of biggest puzzle in modern physics. Idea behind it is that spacetime has quantum nature. General Theory of Relativity is a classical theory but from theoretical point of view quantum physics must apply to gravity. In this paper i will present possible model that describes wave function as tensor field in curved spacetime. That tensor field equation says how much wave function tensor changes with respect to scalar proper time and how much does it change with respect to curvilinear coordinates that are in field equation. Scalar proper time here is with every curvilinear coordinates so there are four proper times but they are in scalar form and are understood as degrees of freedom of wave function. That degrees of freedom tell about scalar part of tensor field.

1 Field equation

For one system field equation for wave function ψ_a, ψ_b, with metric tensor g_{ab} and energy tensor T_{ab} with respect to scalar proper time coordinates σ_a, σ_b and with curvilinear coordinates ζ_a, ζ_b, where κ is a constant, it takes form of:

$$\kappa T_{ab} = \Delta\psi_a \otimes \Delta\psi_b - \frac{1}{2}\frac{\partial}{\partial\zeta_a}\frac{\partial}{\partial\zeta_b} g_{ab} \tag{1}$$

Scalar proper time is a plane in a dimension, it says how much clock changes it value in a direction, in four dimension of spacetime each coordinate has four scalar proper times it means that each coordinate can change in all four directions of scalar proper time. If clock change is constant it's just a four dimension plane, if it's not it's a curve. Wave function ψ_a, ψ_b depends on four scalar proper time time coordinates so writing it as vector i get:

$$\psi_a = \begin{pmatrix} \psi_0(\sigma_0,\sigma_1,\sigma_2,\sigma_3) \\ \psi_1(\sigma_0,\sigma_1,\sigma_2,\sigma_3) \\ \psi_2(\sigma_0,\sigma_1,\sigma_2,\sigma_3) \\ \psi_3(\sigma_0,\sigma_1,\sigma_2,\sigma_3) \end{pmatrix} = \begin{pmatrix} \psi_0(\zeta_0,\zeta_1,\zeta_2,\zeta_3) \\ \psi_1(\zeta_0,\zeta_1,\zeta_2,\zeta_3) \\ \psi_2(\zeta_0,\zeta_1,\zeta_2,\zeta_3) \\ \psi_3(\zeta_0,\zeta_1,\zeta_2,\zeta_3) \end{pmatrix} = \sum_a \psi_a(\zeta_0,\zeta_1,\zeta_2,\zeta_3)\hat{\zeta_a} = \sum_a \psi_a(\sigma_0,\sigma_1,\sigma_2,\sigma_3)\hat{\zeta_a}$$

For many systems this equation takes form of tensor product of system tensors, so for example for two system it's partial derivative of a, b, c, d directions with tensor product of tensors with indices a, b and c, d, writing it for n systems and with notation $a_1, b_1 ... a_n, b_n$ i get:

$$\kappa^n T_{ab} ... \otimes T_{a_n b_n} = \Delta^{(1)}\psi_a \otimes \Delta^{(2)}\psi_b ... \otimes \Delta^{(2n-1)}\psi_{a_n} \otimes \Delta^{(2n)}\psi_{b_n} - \frac{1}{2^n}\frac{\partial}{\partial\zeta_a}\frac{\partial}{\partial\zeta_b} g_{ab} ... \otimes \frac{\partial}{\partial\zeta_{a_n}}\frac{\partial}{\partial\zeta_{b_n}} g_{a_n b_n}$$

Operator Δ is Laplace-Beltrami operator that is equal to:

$$\Delta\psi = \frac{1}{\sqrt{|g|}}\partial_a\left(\sqrt{|g|}g^{ij}\partial_b\psi\right) \tag{2}$$

for each part of tensor wave equation there is one one scalar function that depends on proper scalar time that is equal to curvilinear coordinates.

2 Simplest solutions to field equation

Wave function is a tensor that comes from tensor product of two vector wave functions. simplest case of wave function is:

$$\psi_a(r,t) = \begin{pmatrix} \frac{2\pi iE}{\hbar}\cos(\frac{\omega}{2})e^{i(\omega t \pm kr)} \\ \frac{2\pi E}{\hbar}\cos(\frac{\omega}{2})e^{i(\omega t \pm kr)} \\ 0 \\ 0 \end{pmatrix} \tag{3}$$

Where r is radius and t is time and E is energy, i will get the tensor product of two of those function but only for $a = b$ cases , everywhere where $a \neq b$ i will get zero writing it i get:

$$\psi_{ab}(r,t) = \begin{pmatrix} -\frac{4\pi^2E^2}{\hbar^2}\cos^2(\frac{\omega}{2})e^{2i(\omega t \pm kr)} & 0 & 0 & 0 \\ 0 & \frac{4\pi^2E^2}{\hbar^2}\cos^2(\frac{\omega}{2})e^{2i(\omega t \pm kr)} & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \tag{4}$$

From that wave function tensor i can get a metric tensor that second derivative of wave function solving it i get:

$$g_{ab} = \begin{pmatrix} \cos^2(\frac{\omega}{2})\cos^2(\omega t) & 0 & 0 & 0 \\ 0 & -\cos^2(\frac{\omega}{2})\cos^2\left(\frac{Ml_P\omega r}{Rm_P}\right) & 0 & 0 \\ 0 & 0 & -r^2 & 0 \\ 0 & 0 & 0 & -r^2\sin^2\theta \end{pmatrix} \tag{5}$$

Rest of metric is 2D sphere, first two terms are radius and time. Term $\cos^2(\frac{\omega}{2})$ says about direction of coordinate. Metric tensor coordinates are (t,r,θ,φ) in those it distance takes form of:

$$ds^2 = \cos^2(\frac{\omega}{2})\cos^2(\omega t)c^2dt^2 - \cos^2(\frac{\omega}{2})\cos^2\left(\frac{Ml_P\omega r}{Rm_P}\right)dr^2 - r^2d\theta^2 - r^2\sin^2\theta d\varphi^2 \tag{6}$$

That leads to spacetime loops at energy equal to Planck's energy. Terms in equation (5) and (6) mean R is mass radius, m_P is Planck's mass and ω is frequency divided by Planck's frequency, l_P is Planck's length and M is mass of the system. Spacetime loops appear at inside of a black hole in simplest wave function solution.